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Dai et al.

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(54) **OPTICAL LENS AND LIGHT SOURCE MODULE HAVING THE SAME**

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G02B 19/00 (2006.01)

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CPC ***G02B 19/0061*** (2013.01); ***F21V 5/04*** (2013.01); ***F21V 5/048*** (2013.01); ***G02B 19/0014*** (2013.01)

(58) **Field of Classification Search**
CPC F21V 5/00; F21V 5/04; F21V 5/046; F21V 5/045; F21V 5/048; G02B 3/00; G02B 3/02; G02B 3/04; G02B 3/08; G02B 19/0061; G02B 19/0014
See application file for complete search history.

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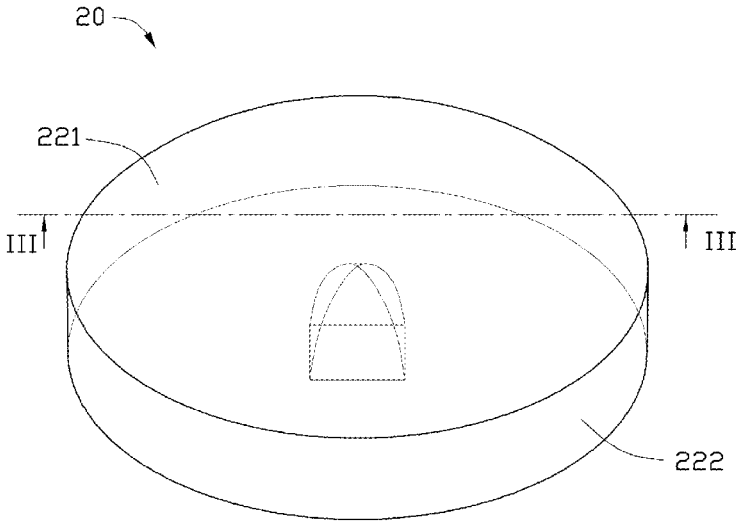
(57) **ABSTRACT**

A light source module includes a light source and an optical lens facing the light source. The optical lens includes a light incident face facing the light source, a light emitting face opposite to the light incident face, and a connecting face connecting the light incident face and the light emitting face. The connecting face is planar. The light emitting face includes a lateral face extending upwardly from an outer periphery of the connecting face and a top face located above the light incident face. The top face of the light emitting face comprises a center curved facet and a periphery curved facet surrounding and extending outwardly from the center curved facet. The light incident face is a discontinuous face and includes a plurality of curved facets.

18 Claims, 5 Drawing Sheets



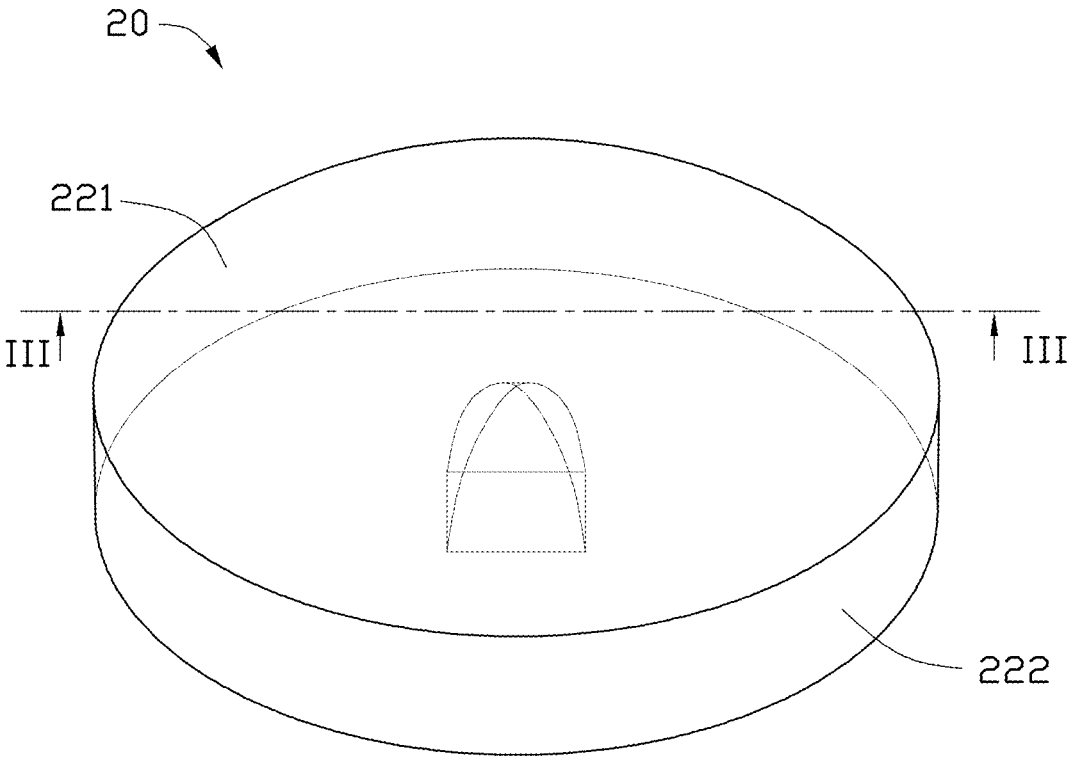


FIG. 1

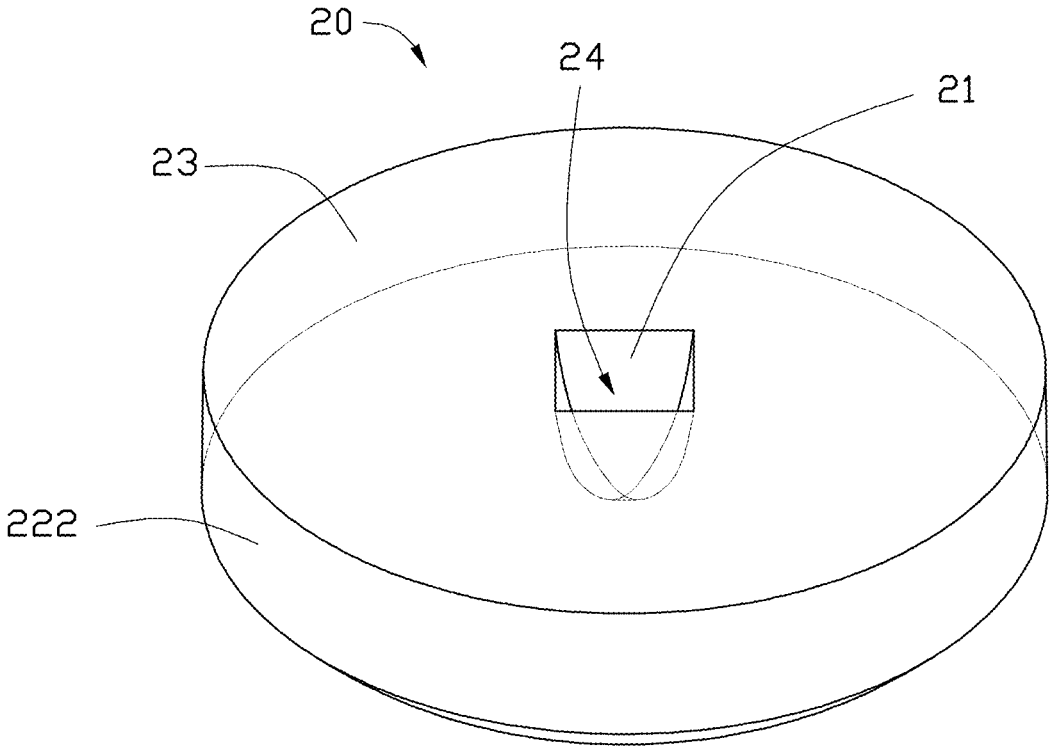


FIG. 2

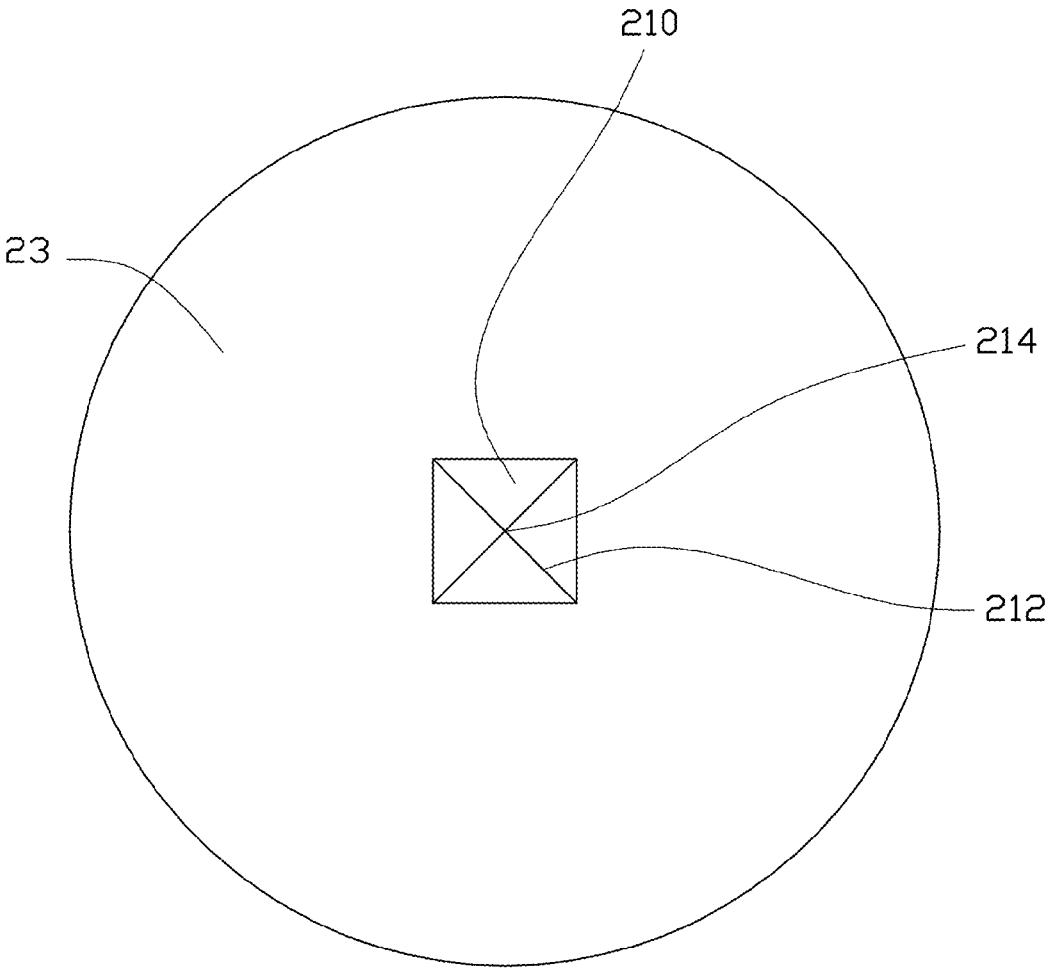


FIG. 3

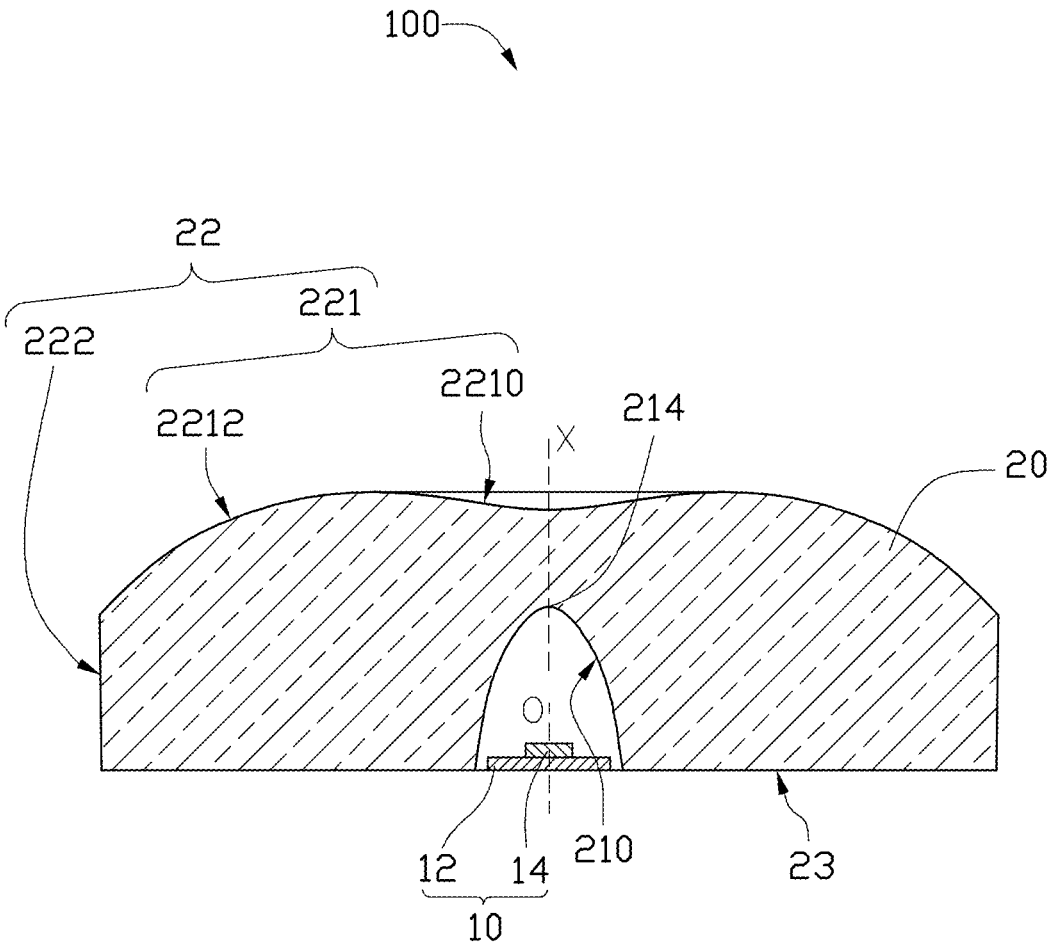


FIG. 4

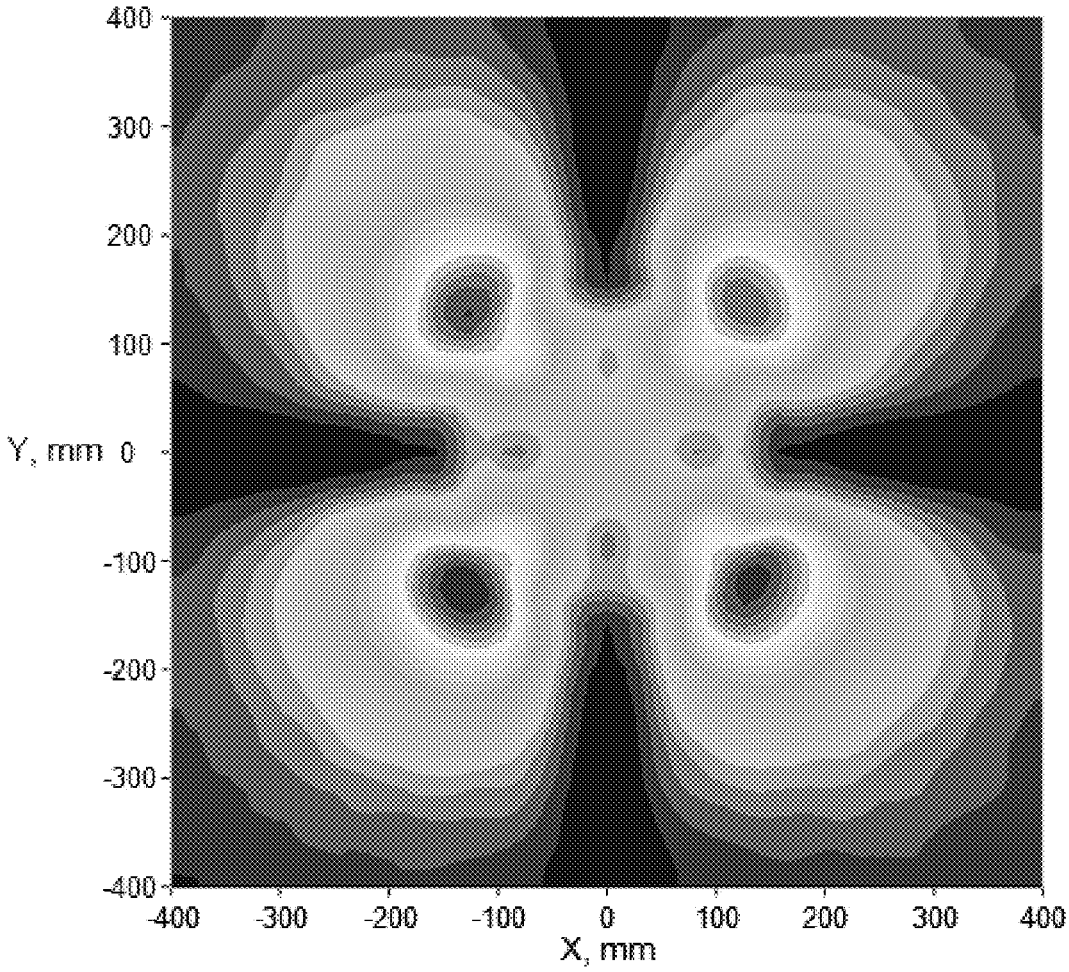

400
300
200
100
Y, mm 0
-100
-200
-300
-400
-400 -300 -200 -100 0 100 200 300 400
X, mm

FIG. 5

OPTICAL LENS AND LIGHT SOURCE MODULE HAVING THE SAME

BACKGROUND

1. Technical Field

The disclosure generally relates to optical lenses, and particularly relates to an optical lens to increase an illuminating angle of a light source and a light source module having the optical lens.

2. Description of Related Art

In recent years, due to excellent light quality and high luminous efficiency, light emitting diodes (LEDs) have increasingly been used as substitutes for incandescent bulbs, compact fluorescent lamps and fluorescent tubes as light sources of illumination devices.

Generally, light intensity of a light emitting diode gradually decreases from a middle portion to lateral sides thereof. Such a feature makes the LED unsuitable for functioning as a light source which needs a wide illumination, for example, a light source for a direct-type backlight module for a liquid crystal display (LCD). In some conditions, it is required to have an optical lens which can help the light emitted from a light emitting diode to have a wider illuminating angle and a special light distribution. Unfortunately, the conventional optical lens and a light source module having the conventional optical lens can not obtain a satisfactory effectiveness.

What is needed, therefore, is an improved optical lens and a light source module having the optical lens to overcome the above described disadvantages.

BRIEF DESCRIPTION OF THE DRAWINGS

Many aspects of the present embodiments can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present embodiments. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. **1** is an isometric view of an optical lens in accordance with an exemplary embodiment of the present disclosure.

FIG. **2** is an inverted view of the optical lens in FIG. **1**.

FIG. **3** is a bottom view of the optical lens in FIG. **1**.

FIG. **4** is a cross section view of the light source module in FIG. **1**, taken along a line IV-IV thereof, wherein a light source is positioned in the optical lens.

FIG. **5** shows a light distribution of a light source module having the optical lens of FIG. **1**.

DETAILED DESCRIPTION

Embodiments of an optical lens and a light source module will now be described in detail below and with reference to the drawings.

Referring to FIGS. **1** through **4**, a light source module **100** in accordance with an exemplary embodiment of the disclosure is illustrated. The light source module **100** includes a light source **10** and an optical lens **20** covering the light source **10**.

The optical lens **20** includes a light incident face **21** facing the light source **10**, a light emitting face **22** opposite to the light incident face **21**, and a connecting face **23** connecting the light incident face **21** and the light emitting face **22**. The light source **10** has an optical axis O, around which light emitted from the light source **10** concentrates in a surrounding space.

In this embodiment of the present disclosure, the light source **10** is a light emitting diode (LED), and includes a supporting base **12** and an LED chip **14** mounted on the supporting base **12**. The supporting base **12** is flat. The supporting base **12** may be made of electrically-insulating materials such as epoxy, silicon or ceramic. The LED chip **14** may be made of semiconductor materials such as GaN, InGaN, AlInGaN or the like. Preferably, the LED chip **14** emits visible light when being activated.

The optical lens **20** is integrally made of transparent materials such as PC (polycarbonate), PMMA (polymethyl methacrylate) or optical glass. It could be understood, a plurality of fluorescence, such as YAG, TAG, silicate, nitride, nitrogen oxides, phosphide, arsenide, telluride or sulfide, could be further provided to mix in the optical lens **20**.

The optical lens **20** is located above and spaced from the light source **10**. A center of a bottom face of the optical lens **20** is recessed inwardly, whereby the light incident face **21** and a receiving space **24** for accommodating the light source **10** are formed. The lateral face **222** is a cylindrical face. The connecting face **23** is an annular and planar face surrounding the light incident face **21**. In use, the connecting face **23** is fitly attached on a supporting face (not shown) supporting the light source **10** and the optical lens **20**. The optical lens **20** defines a central axis X, and the optical lens **20** is rotationally symmetrical relative to the central axis X. The central axis X of the optical lens **20** is aligned with the optical axis O of the light source **10**. The light emitting face **22** is rotationally symmetrical relative to the central axis X.

The light incident face **21** is a discontinuous face and includes a plurality of curved facets **210**. In the embodiment of the present disclosure, there are four curved facets **210**. Each curved facet **210** is bent inwardly and upwardly towards the central axis X. A width of each curved facet **210** gradually decreases along a bottom-to-top direction of the optical lens **20**. A curvature of each curved facet **210** gradually increases along the bottom-to-top direction of the optical lens **20**. Every two adjacent curved facets **210** intersect at a boundary line **212**. In the embodiment of the present disclosure, there are four boundary lines **212**. Each boundary line **212** is curved. The boundary lines **212** intersect at a joint **214**. The joint **214** is positioned at the central axis X. The light incident face **21** is axisymmetric relative to the central axis X. In the embodiment of the present disclosure, a projection of the light incident face **21** on a horizontal plane is a square, an integral projection of the boundary lines **212** on the horizontal plane is two diagonals of the square, and a projection of each curved facet **210** on the horizontal plane is a triangle.

The light emitting face **22** includes a lateral face **222** extending upwardly from an outer periphery of the connecting face **23** and a top face **221** located above the light incident face **21**. The top face **221** of the light emitting face **22** includes a center curved facet **2210** and a periphery curved facet **2212** surrounding and extending outwardly from the center curved facet **2210**. A center of the top face **221** is recessed inwardly, whereby the center curved facet **2210** is formed. The center curved facet **2210** is sculptured, ellipsoidal, spherical or paraboloidal. The center curved facet **2210** is rotationally symmetrical relative to the central axis X. The center curved facet **2210** protrudes toward the light incident face **21**. The periphery curved facet **2212** protrudes away from the light incident face **21**. The periphery curved facet **2212** is sculptured, ellipsoidal, spherical or paraboloidal. The periphery curved facet **2212** is rotationally symmetrical relative to the central axis X. An outer periphery of the periphery curved facet **2212** of the light emitting face **22** correspondingly meets the lateral face **222**.

Referring to FIGS. **1** through **5**, in use, the light emitted from the light source **10** is entered into the optical lens **20** through the curved facets **210** of the light incident face **21** and refracted, then transmitted in the optical lens **20**, and exited and refracted from the center curved facet **2210** and the periphery curved facet **2212** of the top face **221**, and the lateral face **222**, such that an illumination angle of the light source module **100** is widened and a light distribution of the light source module **100** having a shape like a butterfly is obtained.

It is to be further understood that even though numerous characteristics and advantages of the present embodiments have been set forth in the foregoing description, together with details of the structures and functions of the embodiments, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the disclosure to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. An optical lens for adjusting light emitted from a light source, comprising:

a light incident face facing the light source;

a light emitting face opposite to the light incident face; and

a connecting face connecting the light incident face and the light emitting face;

wherein the connecting face is planar, and the light emitting face comprises a lateral face extending upwardly from an outer periphery of the connecting face and a top face located above the light incident face;

wherein the top face of the light emitting face comprises a center curved facet and a periphery curved facet surrounding and extending outwardly from the center curved facet;

wherein the light incident face is a discontinuous face and includes a plurality of curved facets; and

wherein a width of each curved facet gradually decreases along a bottom-to-top direction of the optical lens.

2. The optical lens as claimed in claim **1**, wherein a curvature of each curved facet gradually increases along the bottom-to-top direction of the optical lens.

3. The optical lens as claimed in claim **1**, wherein every two adjacent curved facets intersect at a boundary line, and each boundary line is curved.

4. The optical lens as claimed in claim **3**, wherein there are four curved facets and four boundary lines, the boundary lines intersect at a joint.

5. The optical lens as claimed in claim **4**, wherein a projection of the light incident face on a horizontal plane is a square, an integral projection of the boundary lines on the horizontal plane is two diagonals of the square, and a projection of each curved facet on the horizontal plane is a triangle.

6. The optical lens as claimed in claim **1**, wherein the center curved facet protrudes toward the light incident face, and the periphery curved facet protrudes away from the light incident face.

7. The optical lens as claimed in claim **1**, wherein the center curved facet is sculptured, ellipsoidal, spherical or paraboloidal, the periphery curved facet is sculptured, ellipsoidal, spherical or paraboloidal.

8. The optical lens as claimed in claim **1**, wherein the optical lens defines a central axis, and the optical lens is symmetrical relative to the central axis.

9. The optical lens as claimed in claim **8**, wherein the curved facets intersect at a joint, and the joint is positioned at the axis.

10. A light source module, comprising:

a light source;

an optical lens covering the light source, and the optical lens comprising:

a light incident face facing the light source;

a light emitting face opposite to the light incident face; and

a connecting face connecting the light incident face and the light emitting face;

wherein the connecting face is planar, and the light emitting face comprises a lateral face extending upwardly from an outer periphery of the connecting face and a top face located above the light incident face;

wherein the top face of the light emitting face comprises a center curved facet and a periphery curved facet surrounding and extending outwardly from the center curved facet;

wherein the light incident face is a discontinuous face and includes a plurality of curved facets; and

wherein a width of each curved facet gradually decreases along a bottom-to-top direction of the optical lens.

11. The light source module as claimed in claim **10**, wherein a curvature of each curved facet gradually increases along the bottom-to-top direction of the optical lens.

12. The light source module as claimed in claim **10**, wherein every two adjacent curved facets intersect at a boundary line, and each boundary line is curved.

13. The light source module as claimed in claim **12**, wherein there are four curved facets and four boundary lines, the boundary lines intersect at a joint.

14. The light source module as claimed in claim **13**, wherein a projection of the light incident face on a horizontal plane is a square, an integral projection of the boundary lines on the horizontal plane is two diagonals of the square, and a projection of each curved facet on the horizontal plane is a triangle.

15. The light source module as claimed in claim **10**, wherein the center curved facet protrudes toward the light incident face, and the periphery curved facet protrudes away from the light incident face.

16. The light source module as claimed in claim **10**, wherein the center curved facet is sculptured, ellipsoidal, spherical or paraboloidal, the periphery curved facet is sculptured, ellipsoidal, spherical or paraboloidal.

17. The light source module as claimed in claim **10**, wherein the optical lens defines a central axis, and the optical lens is symmetrical relative to the central axis.

18. The light source module as claimed in claim **17**, wherein the curved facets intersect at a joint, and the joint is positioned at the axis.

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